

GHaFaS: Galaxy Halpha Fabry-Perot Spectrometer for the WHT

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Abstract. A new scanning Fabry-Perot system will soon be available at the Nasmyth focus of the 4,2m William Hershell Telescope (WHT). It has been designed by the Laboratoire d'Astrophysique Expérimentale (LAE) in Montréal and is being built in collaboration with astronomers at the Instituto de Astrofísica de Canarias (IAC). The instrument will see first light at the beginning of July 2007.

Description of the Projet

GHaFaS is an improved version of the scanning Fabry-Perot system FaNTomM (Hernandez et al. 2003), which is a resident instrument on the Observatoire du mont Mégantic (OMM) 1,6m telescope and which has also been used on the CFH and ESO La Silla 3,6m telescopes. The complete system is composed of a focal reducer, a calibration unit, a filter wheel for the order sorter filters, an FP etalon and an IPCS camera. The IPCS is composed of an Hamamatsu intensifier MCP tube which intensifies every generated electron coming from the photocatode by a factor 10^7 . Each photon event, recorded on a DALSA CCD, is then analysed by a centering algorithm. With this amplification, the camera has essentially no readout noise. Because of this, a zero noise IPCS is to be preferred to CCDs at very low flux level (Gach et al. 2002), even if the GaAs IPCS has only a DQE of 25%. Moreover, because of the fast scanning capability, it can average out the variation of atmospheric transmission which is not possible with the long integration times needed per channel for the CCDs in order to beat the read-out noise.

In the last 3 years with the FaNTomM system, around 150 galaxies were observed on the OMM, CFH and ESO La Silla telescopes in the context of 3 large surveys: the SINGS sample (Daigle et al. 2006), a survey of barred galaxies, the BHabar sample (Hernandez et al. 2005) and a sample of Virgo spirals (Chemin et al. 2006). While the first scientific justification of the Montréal group was to derive high spatial resolution optical rotation curves for mass modeling purposes, the data was also used by IAC astronomers to constrain the role of gravitational perturbations as well as feedback from individual HII regions on the evolution of structures in galaxies and by a Berkeley-Munich group and the GÉPI group in Paris to compare those local samples to high z galaxies.

GHaFaS will come with its own custom designed focal reducer developed to be optically and mechanically compatible with the Nasmyth focus of the WHT. The system has its own control and data acquisition system. It will have a 4x4 arcmin field with a 0.45 arcsec pixel and ~ 5 km/s velocity resolution. Full acquisition and reduction software (mainly based on IDL routines) will be provided by the Montréal group. The project will be done in 3 phases. For Phase I (July 2007), the optical system (focal reducer, filter wheel & calibration unit) will be delivered to the WHT and used with the camera FaNTOmM for this first run. For Phase II (end of 2007), an improved GaAs IPCS will be added to the system. Phase III (early 2008) will provide an FP controller and possibly a monochromator to calibrate the data at the observing wavelength.

Science to be done with GHaFaS

Two-dimensional kinematics is a very powerful technique for studying the structure and evolution of galaxies. The distribution of dark matter, circumnuclear star formation and fuelling of active galactic nuclei, detection of counter-rotating and kinematically decoupled components, and the effects of interaction between massive stars and the interstellar medium are among the physical phenomena which can be studied with this technique: see e.g. Fathi et al. (2007) and Relaño et al. (2007).

The first large program for which we plan to use GHaFaS consists at observing a sample of 46 carefully selected nearby galaxies which are all included in the SINGS, THINGS, GALEX, and other CO and optical archives. Due to the angular size of some of the objects, 2-4 fields may be necessary to reach the 25th magnitude radius. This totals to 72 fields which will require ~ 18 clear nights of observing with GHaFaS on the WHT. Priority will be given to enlarge our Virgo sample of galaxies. The full sample ranges from elliptical (with emission) to irregular galaxies, 2/3 of which are intermediate-type objects, since this is where highly star-forming regions will be observed. It will be possible to use this sample for many scientific projects ranging from the large scale mass modeling using the velocity fields in order to derive the dark matter density profiles to the study of the internal kinematics of the individual HII regions.

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